IN THE MATTER OF

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By Samsung Electronics Co., Ltd

I, Mi-sun Rhee, an employee of Y.P.LE, MOCK & PARTNERS of The Cheonghwa Bldg., 1571-18 Seocho-dong, Seocho-gu, Seoul, Republic of Korea, hereby declare that I am familiar with the Korean and English language and that I am the translator of U.S. Provisional Application and certify that the following is to the best of my knowledge and belief a true and correct translation.

Signed this 24th day of October 2003

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RECORDING MEDIUM CAPABLE OF STORING STILL IMAGE DATA AND AUXILIARY DATA, AND APPARATUSES FOR RECORDING DATA ON AND REPRODUCING DATA FROM THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a recording medium capable of storing still image data and auxiliary data, and apparatuses for recording data on and reproducing data from the recording medium.

2. Description of the Related Art

Motion image data has a considerable amount of information and needs to be temporally and spatially compressed before being recorded. MPEG encoding that has been authorized by both ISO and IEC has been most widely used as a method of compressing and encoding motion image information. Audio data, which is generally encoded together with image data, is also compressed using an MPEG encoding method, or non-compressed digital data, such as linear pulse code modulation (PCM) data, is directly used as audio data. Time information necessary to synchronized encoded motion image data with encoded audio data is allotted to the encoded motion image data and the encoded audio data, and then the encoded motion image data and the encoded audio data are multiplexed. A MPEG-2-based encoding method is generally used to compress motion image data and audio data. FIG. 1 shows a hierarchy encoding method, which is one of MPEG-based encoding methods.

Referring to FIG. 1, digitalized audio and video data are encoded by an audio encoder and a video encoder, respectively. Data output from the audio encoder and data output from the video decoder are processed into packetized elementary streams (PES) packet data by their corresponding packetizer. The PES packet data are multiplexed into a program stream and a transport stream, respectively, by a program stream multiplexer and a transport stream multiplexer, respectively.

The PES packet data is multiplexed so that different identification numbers are allotted to PES packets. A program stream (PS) is developed to be used in a data storage medium, and its multiplexing unit is a PS pack. According to

DVD-video standard, the program stream is multiplexed into PS packs each comprised of 2048 bytes.

A transport stream (TS) is developed for digital broadcasting applications where data loss is more likely to occur. When the transport stream is multiplexed into transport stream packets, each transport stream packet size is fixed to 188 bytes. An increasing number of application programs adopt transport streams to record digital broadcast data on a storage medium. Even though in the present invention, multiplexed transport streams are adopted, the present invention can also be applied to a case where program streams are adopted.

FIG. 2 shows the structure of a PES packet. A PES packet begins with packet_start_code_prefix, which accounts for 32 bits and indicates the beginning of a new PES packet. stream_id is information indicating whether the corresponding PES packet is for audio or video data defined by MPEG. The identification information stream_id may also be used to indicate whether the corresponding PES packet is for a private stream. The private stream may be uncompressed linear pulse code modulation (LPCM) audio data or AC3-compressed audio data. If data contained in the corresponding PES packet is data encoded by an MPEG encoding method, presentation-time-stamp (PTS) information and decoding-time-stamp (DTS) information may be added thereto. The PTS information and the DTS information are used to synchronize their corresponding data with other data and specify the time when an image will be output and the time when the image will be decoded, respectively. In general, audio data only has the PTS information on the assumption that PTS and DTS are basically the same. The data, to which the DTS and PTS information are added, is packetized in a payload data form.

FIG. 3 shows the structure of transport stream packet. Referring to FIG. 3, sync_byte, which accounts for 8 bits, indicates the beginning of a new packet. PID represents program identification and is used for identifying which PES packet the corresponding transport stream packet constitutes. In other words, a single PES packet can be restored by gathering payload data distributed in a plurality of transport stream packets having the same PID. Program clock reference (PCR), which indicates the time when the TS packet is input into a decoding buffer, may be further contained in the transport stream packet. PCR is used for synchronizing decoder time clocks with encoder time clocks.

FIG. 4 shows an MPEG hierarchy encoding method, and FIG. 5 is a block diagram illustrating a standard decoder for synchronization using a variety of encoding time information, such as PCR, PTS, and DTS. In general, a decoder includes a clock, which is constituted by a counter that operates at a frequency of 90 KHz or 27 Mhz. The decoder controls a packet input thereinto so that a count value of the packet can be equal to a PCR value of the packet. The counter is called a system time clock (STC). Audio data and video data can be synchronized with each other by one clock controlling the decoding and outputting of the audio data and the video data based on a STC value and PTC and/or DTS. In other words, a single clock controls decoding of audio and video data so that the decoded audio data and the decoded video data can be synchronized with each other.

FIG. 6 shows inputting and outputting of data according to a counter value of a clock and a data buffering state of a decoder. The time when a packet is input into a buffer is specified in the packet's PCR. Data in the packet is decoded at a moment of time specified in PTS and DTS, and then the buffer empties. Video data and audio data that are output at the same time are supposed to have the same PTS value. An encoder sets encoding time and controls a data bit rate in order to prevent the buffer from overflowing or underflowing with data. This process is more appropriate for motion images. Still images can be dealt with differently by two other applications. In one application, still images are output at a predetermined moment of time. More specifically, when a user selects a 'reverse play' or 'skip' operation to search for a predetermined previous image that has already been reproduced, image reproduction is stopped for a while for the selected operation and then resumed by renewing an STC value. In the case of a still image to which audio data is added, the audio data is reproduced in synchronization with a renewed still image. Therefore, when still image reproduction is stopped, corresponding audio data reproduction is also stopped, and then when new still images begin to be reproduced, their corresponding audio data is reproduced. This type of still image reproduction is called a slide show.

FIG. 7 is a diagram illustrating such a slide show. Each still image and corresponding audio data are synchronized with each other by PTS information, which is encoding time information for data synchronization. While still images are normally reproduced, an STC value of a decoder continues to increase. However, if a user selects a reverse play or skip operation for reproduction of a specific previous

image, the STC backtracks to the count value corresponding to the specific previous image. By renewing the STC value in this manner, audio and still image data, corresponding to the renewed STC value, are reproduced in synchronization with each other.

There is another example of still image reproduction, i.e., a browsable slide show, which will be described in the following paragraph with reference to FIG. 8. FIG. 8 is a diagram illustrating a browsable slide show. In the browsable slide show, audio data reproduction should not be stopped even when a user selects a reverse play or skip operation. In this regard, however, a conventional data reproduction apparatus, a data structure and a multiplexing method are not suitable for such a browsable slide show.

SUMMARY OF THE INVENTION

The present invention provides a recording medium on which still image data having a structure that leaves a lot of application possibilities and auxiliary data are recorded, and apparatuses for recording data on and reproducing data from the recording medium.

According to an aspect of the present invention, there is provided a recording medium, on which still image data and additional data necessary for reproduction of the still image data are recorded. Here, the still image data is MPEG-encoded, a plurality of still images are grouped into clips and recorded on the recording medium on a clip-by-clip basis, each still image is multiplexed and recorded together with graphic and/or subtitle data, which will be reproduced with the corresponding motionless data, and is encoded in a manner that gives the corresponding still image program clock reference (PCR) and presentation time stamp (PTS) values, which start from 0 or a very small number, the still image data constitutes a single system time clock (STC) sequence, for which a MPEG-defined time stamp value monotonously increases, the additional data is classified into clip information concerning a recording structure of a clip and play list information concerning a reproduction structure of the still image data so that the clip information and the play list information are separately recorded on the recording medium, the clip information is comprised of STC sequence information containing information on a STC sequence in the clip, the play list information is comprised of a plurality of pieces of play item information, and play item information is information on a single still image.

Preferably, the STC sequence information is comprised of location information of a still image in the clip, and the presentation start time and presentation end time of the STC sequence. Preferably, the play item information is comprised of clip information identification data, STC sequence identification data, and in-time and out-time of the STC sequence, and the in-time and the out-time represent predetermined moments of time between the presentation start time and presentation end time of the STC sequence.

Preferably, the still image is encoded into an I-picture and sequence end codes.

Preferably, the presentation end time is represented by 0 or any conceivable greatest number under given circumstances when the STC sequence has infinite presentation time.

Preferably, the out-time of the play item is set to 0 or any conceivable greatest number under given circumstances when a play item has infinite presentation time.

Preferably, if audio data is attached to a still image in a play list recorded on the recording medium, sub-play item information on the audio data is further recorded on the recording medium.

Preferably, the audio data is comprised of an audio clip is recorded on the recording medium together with audio clip information concerning a recording structure of the audio clip. Preferably, the audio clip is encoded so that MPEG-defined PCR and PTS values for the audio clip gradually increase from 0 or another very small number. Preferably, the audio clip constitutes a single STC sequence for which an MPEG-defined time stamp value monotonously increases, and the sub-play item information is comprised of audio clip information identification data, and in-time and out-time of the STC sequence. The in-time and the out-time represent predetermined moments of time between the presentation start time and presentation end time of the STC sequence.

According to another aspect of the present invention, there is provided an apparatus for reproducing data from a recording medium, which includes a data input device, a track buffer, a central control device, a memory device, and a system decoder. On the recording medium, still image data and additional data necessary for reproduction of the still image data are recorded. Here, the still image data is MPEG-encoded, a plurality of still images are grouped into clips and recorded on the recording medium on a clip-by-clip basis, each still image is multiplexed and

recorded together with graphic and/or subtitle data, which will be reproduced with the corresponding motionless data, and is encoded in a manner that gives the corresponding still image program clock reference (PCR) and presentation time stamp (PTS) values, which start from 0 or a very small number, the still image data constitutes a single system time clock (STC) sequence, for which a MPEG-defined time stamp value monotonously increases, the additional data is classified into clip information concerning a recording structure of a clip and play list information concerning a reproduction structure of the still image data so that the clip information and the play list information are separately recorded on the recording medium, the clip information is comprised of STC sequence information containing information on a STC sequence in the clip, the play list information is comprised of a plurality of pieces of play item information, and play item information is information on a single still image.

The clip information and the play list information are read from the recording medium using the data input device and then stored in the memory device. When reproducing a play list, the still image in the clip is searched for and then temporarily stored in the track buffer via the data input device. Thereafter, the still image is decoded using the system decoder.

Preferably, the STC sequence information is comprised of location information of the still image in the clip, and the presentation start time and presentation end time of the STC sequence. Preferably, the play item information is comprised of clip information identification data, STC sequence identification data, and in-time and out-time of the STC sequence, and the in-time and the out-time represent predetermined moments of time between the presentation start time and presentation end time of the STC sequence. Preferably, reproduction of a play item only covers still image data between data corresponding to the in-time of the play item and data corresponding to the out-time of the play item.

Preferably, the still image recorded on the recording medium is MPEG-encoded into an I-picture and sequence end codes. Preferably, the I-picture and the sequence end codes are decoded and output so that the still image data ranging from the data corresponding to the in-time and the data corresponding to the out-time are reproduced.

Preferably, the presentation end time is represented by 0 or any conceivable greatest number under given circumstances when the STC sequence has infinite

presentation time. Preferably, reproduction of a play item only covers still image data between data corresponding to the in-time of the play item and data corresponding to the out-time of the play item.

Preferably, the out-time of the play item is set to 0 or any conceivable greatest number under given circumstances when a play item has infinite presentation time. Preferably, in the case of reproducing a play item having infinite presentation time, the apparatus reproduces a corresponding still image until a user input is issued.

Preferably, if audio data is attached to a still image on a play list recorded on the recording medium, sub-play item information on the audio data is further recorded on the recording medium. Preferably, the apparatus reproduces the audio data attached to the still image on the play list together with the corresponding still image.

Preferably, the audio data is comprised of an audio clip and is recorded on the recording medium together with audio clip information, concerning a recording structure of the audio clip. Preferably, the audio clip is encoded so that MPEG-defined PCR and PTS values for the audio clip gradually increase from 0 or another very small number. Preferably, the audio clip constitutes a single STC sequence for which an MPEG-defined time stamp value monotonously increases, and the sub-play item information is comprised of audio clip information identification data, and in-time and out-time of the STC sequence. Preferably, the in-time and the out-time represent predetermined moments of time between the presentation start time and presentation end time of the STC sequence. Preferably, the apparatus reproduces audio data ranging from audio data corresponding to the in-time and audio data corresponding to the out-time.

Preferably, the system decoder includes a clock exclusively provided for audio data decoding so that audio data can be seamlessly reproduced even when a user inputs a signal to reproduce a still image before or after a current still image.

According to another aspect of the present invention, there is provided an apparatus for recording data on a recording medium, which includes a central control device, a memory device, a non-portable storage device, a track buffer, and a data output device. Still image data is MPEG-encoded; a plurality of still images are grouped into clips and recorded in the non-portable storage device on a clip-by-clip basis; each still image is multiplexed and recorded together with graphic and/or subtitle data, which will be reproduced with the corresponding motionless data, and

is encoded in a manner that gives the corresponding still image PCR and PTS values, which gradually increase from 0 or another very small number; the still image data constitutes a STC sequence, for which a MPEG-defined time stamp value monotonously increases; additional data is classified into clip information concerning a recording structure of a clip and play list information concerning a reproduction structure of the still image data so that the clip information and the play list information are recorded in different places in the non-portable storage device; the clip information is comprised of STC sequence information containing information on a STC sequence in the clip; the play list information is comprised of a plurality of pieces of play item information; and play item information is information on a single still image. The still image data and the additional data are stored in the non-portable storage device. The central control device sequentially reads the still image data and the additional data from the non-portable storage device and stores it in the memory device. Thereafter, the central control device records the clip, the clip information, and the play list information, on the recording medium via the track buffer and the data output device.

Preferably, the STC sequence information is comprised of location information of the still image in the clip, and the presentation start time and presentation end time of the STC sequence. Preferably, the play item information is comprised of clip information identification data, STC sequence identification data, and in-time and out-time of the STC sequence, and the in-time and the out-time represent predetermined moments of time between the presentation start time and presentation end time of the STC sequence. Preferably, the apparatus records the STC sequence information and the play item information on the recording medium.

Preferably, the still image is MPEG-encoded into an I-picture and sequence end codes, and the apparatus records the I-picture and the sequence end codes on the recording medium.

Preferably, when the STC sequence has infinite presentation time, the presentation end time is represented by 0 or any conceivable greatest number under given circumstances. Preferably, the apparatus records the presentation end time on the recording medium.

Preferably, when a play item has infinite presentation time, the out-time of the play item is set to 0 or any conceivable greatest number under given circumstances.

Preferably, the apparatus records the out-time of the play item on the recording medium.

Preferably, if audio data attached to a still image on a play list is further contained in the non-portable storage device, sub-play item information on the audio data is further recorded in the non-portable storage device. Preferably, the apparatus records the audio data and the sub-play item information on the recording medium.

Preferably, the audio data is comprised of an audio clip and is recorded in the non-portable storage device together with audio clip information concerning a recording structure of the audio clip. Preferably, the audio clip is encoded so that MPEG-defined PCR and PTS values for the audio clip gradually increase from 0 or another very small number. Preferably, the audio clip constitutes a single STC sequence for which an MPEG-defined time stamp value monotonously increases, and the sub-play item information is comprised of audio clip information identification data, and in-time and out-time of the STC sequence. Preferably, the in-time and the out-time represent predetermined moments of time between the presentation start time and presentation end time of the STC sequence. Preferably, the apparatus records the audio data and the audio clip information on the recording medium.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a diagram illustrating a hierarchy encoding method used in MPEG system encoding;

FIG. 2 is a diagram illustrating the structure of a packet elementary system (PES) packet;

FIG. 3 is a diagram illustrating the structure of a transport stream packet;

FIG. 4 is a diagram illustrating a hierarchy encoding method proposed by MPEG;

FIG. 5 is a diagram illustrating the structure of a standard decoder for synchronizing video data with audio data using encoding time information, such as

program clock reference (PCR) information, presentation time stamp (PTS) information, or decoding time stamp (DTS) information;

FIG. 6 is a diagram illustrating inputting and outputting of data according to a counter value of a clock and a data buffering state of a decoder;

FIG. 7 is a diagram illustrating a decoding process in a still image slide show according to an STC value;

FIG. 8 is a diagram illustrating a decoding process in a still image browasable show according to an STC value;

FIG. 9 is a block diagram illustrating a decoder, according to a preferred embodiment of the present invention, including clocks for controlling system time clock (STC) values for audio data and video data;

FIG. 10 is a diagram illustrating the structure of a data file according to a preferred embodiment of the present invention;

FIG. 11 is a diagram illustrating relationship among a play list, clip information, which is recording data structure information, and a clip, which is recorded data;

FIG. 12 is a diagram illustrating a plurality of play items showing different default reproduction periods of time;

FIG. 13 is a diagram illustrating a plurality of play items and sub-play items;

FIG. 14 is a diagram illustrating the structure of clip information concerning the structure of a clip, which is a data recording unit;

FIG. 15 is a diagram illustrating an example of SequenceInfo;

FIG. 16 is a diagram illustrating an example of EP_map information, which is one of important pieces of characteristic point information (CPI);

FIG. 17 is a diagram illustrating an example of a ply item, which is data reproduction structure information;

FIG. 18 is a block diagram illustrating a data reproduction apparatus according to a preferred embodiment of the present invention; and

FIG. 19 is a block diagram illustrating a data recording apparatus according to a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, the present invention will be described more fully with reference to the accompanying drawings, in which preferred embodiments of the invention are shown.

FIG. 7 is a diagram illustrating a decoding process in a still image slide show according to a system time clock (STC) value, and FIG. 8 is a diagram illustrating a decoding process in a still image browsable slide show according to an STC value.

The structure of data subjected to a browsable slide show is comprised of the following items.

1) Still image data encoded in an MPEG encoding method and then recorded on a recording medium

2) STC sequence information concerning the location and encoding time of each still image

3) Play items including reproduction time and identification information of still images to be reproduced

4) Play list of such play items

5) Audio stream containing audio data

6) Sub-play items for audio data

Referring to FIG. 8, still images are reproduced at their respective default reproduction moments of time that have been set in advance. Audio data, if it is added to the still images, are reproduced correspondingly, based on PTS information attached thereto. If a user selects a reverse play or skip operation for reproduction of a specific previous image, reproduction of a current still image is stopped, and reproduction of the specific previous image is started. However, audio data is seamlessly reproduced. This type of still image reproduction may include a digital photo album displayed in a manner that reproduces still images together with background music. Therefore, an STC value for audio data needs to keep increasing, and in order to make this happen, separate clocks are provided for audio data and video data so as to separately control STC values for the audio data and the video data. By doing so, the STC value for the audio data can keep increasing, even though the STC value for the video data is renewed. The video data and the audio data are preferably recorded on different places of a recording medium. In other words, since in this case, there is no need to synchronize the video data with the audio data, the video data and the audio data may be recorded on different places of a recording medium and read from the recording medium separately by different decoders.

FIG. 10 is a diagram illustrating the structure of a data file according to a preferred embodiment of the present invention. Still image data is encoded so that its corresponding program clock reference (PCR) and presentation time stamp (PTS) values start from zero or a very small value. A plurality of still images are preferably recorded in a single recording space, and the recording space is preferably regarded as a single file. Each still image may be accompanied by graphic data or subtitle data, which is supposed to be reproduced together with the corresponding still image. The graphic data or the subtitle data may have its own PTS value, which gradually increases in accordance with the passage of time. For example, graphic animation or subtitle data, which varies in accordance with the passage of time, may be displayed on each still image. In a case where such additional data as graphic data or subtitle data is attached to a single still image, the beginning of encoding time of the still image can be easily set to a predetermined small value, but the end of the encoding time of the still image cannot be determined until the running time of the additional data is figured out. In other words, the end of the encoding time of the still image is determined depending on the ending time of the additional data. According to the MPEG standard, a predetermined unit, for which encoding time information, such as PCR and PTS, has a gradually increasing value, is called a STC sequence (STC_sequence). In the present invention, the beginning of each still image data, including a still image, graphic data, and/or subtitle data, is set to a predetermined small value, for example, 0, irrespective of the location of the corresponding still image data, and thus a single piece of still image data constitutes a single STC sequence. A still image file is comprised of a plurality of STC sequences. The beginning of each STC sequence needs to be separately managed as additional information so as to facilitate searches for pieces of still image data.

Audio data may be further attached to the still image data or may not. If audio data is attached to the still image data, the audio data is preferably recorded into a single audio file with an STC value gradually increasing. In this case, the audio data is considered as constituted by a single STC sequence.

When still image data and audio data are recorded into a file according to the MPEG standard, the present invention calls the file 'clip' and treats it as a recording unit. To each recording unit, i.e., each clip, recording structure information, which is called 'clip information', is attached. Clip information for still image data includes

sequence information, which is a group of pieces of information on a STC sequence corresponding to each still image data. More specifically, clip information includes the beginning of a STC sequence corresponding to each still image data, and presentation start time (PST) and presentation end time (PET) of each still image data. The PSE of each still image data may be determined in the above-described manner. For example, the PST of each still image data may be set to 1/30 sec. Preferably, the PST of each still image data is equal to PTS of the corresponding still image data. PET indicates the end of running time of graphic data or subtitle data included in each still image data. The PET of still image data, including a still image and additional data that is output together with the still image and does not change, may be the same as the end of running time of one frame image. On the other hand, if the still image data includes variable additional data, such as subtitles that are variably output over 10 seconds, the PET is delayed by as much as 10 seconds from the end of the running time of one frame image. In a preferred embodiment of the present invention, PET is set to an infinite value, which can be represented by, for example, 0 or any conceivable greatest number under given circumstances (e.g., 0×FFFFFFFF in a 32-bit representation manner).

In the present invention, reproduction structure information, such as a reproduction order and default reproduction time, is created and reproduced. The reproduction structure information is called a play list. FIG. 11 illustrates relationship among a play list, clip information, which is recording structure information, and a clip, which is recorded data.

Referring to FIG. 11, a play list is comprised of a plurality of play items, and a sequence of these play items is reproduced first. Each play item indicates a still image and includes various pieces of information, such as Clip_Information_file_name, ref_to_STC_id, IN_time, and Out_time. Clip_Information_file_name is the name of a file containing recording structure information of a clip file containing a still image designated by the corresponding play item, i.e., clip information of the designated still image. ref_to_STC_id indicates identification information of each STC sequence (STC_sequence) in the clip file. As described above, a still image constitutes a single STC sequence, and STC sequences are sequentially recorded in one clip. Therefore, where the still images stand in the recording order may be used as identification numbers for the still images. IN_time indicates a predetermined moment of time between

presentation_start_time and presentation_end_time of STC_sequence. In the case of still image data, IN_time and presentation_start_time are preferably the same moment of time. Especially, in the case of still image data that has been encoded by an MPEG encoding method into I pictures and sequence end codes, IN_time and presentation_start_time must indicate the same moment of time. Out_time could be any moment of time between presentation_start_time and presentation_end_time of STC_sequence as long as it is later than the predetermined moment of time indicating IN_time. Out_time and presentation_end_time preferably indicate the same moment of time. However, Out_time may be earlier than presentation_end_time, in which case reproduction of the corresponding play item only covers data corresponding to a range between IN_time and Out_time and the remainder of the corresponding play item is exempted from the reproduction. The concepts of IN_time and Out_time and the relationship among IN_time, Out_time, and presentation_start_time and presentation_end_time of STC_sequence may also be applicable to motion picture structures.

The present embodiment of the present invention is very useful when presentation_end_time indicates an infinite moment of time. In other words, if the ending time of still image data is set to infinity, a single still image can be reproduced in different play items at different default reproduction moments of time, as shown in FIG. 12, by allowing each play item corresponding to have a value necessary for controlling the actual output time of the still image data. Furthermore, Out_time may set to infinity, in which Out_time is represented by 0 or any conceivable greatest number under given circumstances (e.g., 0×FFFFFFFF in a 32-bit representation manner). Reproduction of still image data having infinite reproduction time is carried out in a manner that stops outputting the still image data when a user selects reproduction of a previous or subsequent still image and then reproduces the previous or subsequent still image.

FIG. 14 is a diagram illustrating the structure of clip information, which is recording structure information of a data recording unit, i.e., a clip. Clip information is comprised of SequenceInfo and characteristic point information (CPI).

FIG. 15 is a diagram illustrating an example of SequenceInfo. As shown in FIG. 15, SequenceInfo includes num_stc, which indicates the number of STC sequences in a clip, Position, which indicates the location of each STC sequence,

and presentation_start_time, and present_end_time. This structure may also be directly applied to motion images.

FIG. 16 is a diagram illustrating an example of EP_map, which is one of important pieces of CPI. EP_map is additional information concerning an entry point of a clip. In an MPEG encoding method, an entry point indicates the beginning point of an image that is encoded into an I picture. Each still image is preferably comprised of an MPEG-I-picture and sequence end codes and serves as an entry point. EP_map includes Num_of_entry_point, which indicates the number of entry points in the clip, and the position and PTS value of each entry point. In the case of still image data, the position of each entry point is identical to presentation_start_time, and thus CPI is unnecessary. However, in the case of a motion image, CPI is necessary for random searches.

FIG. 17 is a diagram illustrating an example of a play item, which is reproduction structure information

FIG. 18 is a block diagram illustrating a data reproduction apparatus according to a preferred embodiment of the present invention. The data reproduction apparatus includes a data input device, a track buffer, a system decoder, a central control device, and a memory device. Data is read from a recording medium by the data input device. Such additional data as clip information and play list information is transmitted to the central control device and temporarily stored in the memory device. The central control device searches for the play list information and analyses play item information in the play list information. The central control device identifies the locations of a predetermined still image and a corresponding audio file and the predetermined still image and audio data from the identified locations using the data input device. The read still image and audio data are buffered through the track buffer and input into the system decoder. Since the system decoder includes a clock exclusively for audio data control, as described above with reference to FIG. 9, the audio data can be seamlessly reproduced even though a user carries out a reverse play or skip operation in the middle of browsable reproduction.

FIG. 19 is a block diagram illustrating a data recording apparatus according to a preferred embodiment of the present invention. In a non-portable storage device, a plurality of MPEG-encoded, still images are stored into each clip, and clip information and play list information (i.e., data reproduction structure information) for

each clip are recorded. A central control device reads data from the non-portable storage device and temporarily stores the read data in a memory device. Thereafter, the corresponding data is recorded on a recording medium via a track buffer and a data output device.

The present invention may be realized as computer-readable codes that are written on a computer-readable recording medium. The computer-readable recording medium includes any types of storage devices from which data can be read by a computer system. The computer-readable recording medium includes ROM, RAM, CD-ROM, a magnetic tape, a floppy disk, an optical data storage device, and a carrier wave (such as data transmission through the Internet). In addition, the computer-readable recording medium may be distributed over a plurality of computer systems connected to one another via a network, in which case the present invention can be realized as computer-readable codes that are written on the computer-readable recording medium in a decentralized manner.

As described above, the recording medium, on which still image data and additional data are recorded, and the apparatuses for recording data on and reproducing data from the recording medium, according to the present invention, provide a predetermined still image structure that enhances their applicability.

What is claimed is:

1. A recording medium, on which still image data and additional data necessary for reproduction of the still image data are recorded,

wherein the still image data is MPEG-encoded; a plurality of still images are grouped into clips and recorded on the recording medium on a clip-by-clip basis; each still image is multiplexed and recorded together with graphic and/or subtitle data, which will be reproduced with the corresponding motionless data, and is encoded in a manner that gives the corresponding still image program clock reference (PCR) and presentation time stamp (PTS) values, which start from 0 or a very small number; the still image data constitutes a single system time clock (STC) sequence, for which a MPEG-defined time stamp value monotonously increases; the additional data is classified into clip information concerning a recording structure of a clip and play list information concerning a reproduction structure of the still image data so that the clip information and the play list information are separately recorded on the recording medium; the clip information is comprised of STC sequence information containing information on a STC sequence in the clip; the play list information is comprised of a plurality of pieces of play item information; and play item information is information on a single still image.

Abstract of the Disclosure

Provided are a recording medium, on which still image data and additional data are stored, and apparatuses for recording data on and reproducing data from the recording medium. On the recording medium, still image data and additional data necessary for reproduction of the still image data are recorded. Here, the still image data is MPEG-encoded, a plurality of still images are grouped into clips and recorded on the recording medium on a clip-by-clip basis, each still image is multiplexed and recorded together with graphic and/or subtitle data, which will be reproduced with the corresponding motionless data, and is encoded in a manner that gives the corresponding still image program clock reference (PCR) and presentation time stamp (PTS) values, which start from 0 or a very small number, the still image data constitutes a single system time clock (STC) sequence, for which a MPEG-defined time stamp value monotonously increases, the additional data is classified into clip information concerning a recording structure of a clip and play list information concerning a reproduction structure of the still image data so that the clip information and the play list information are separately recorded on the recording medium, the clip information is comprised of STC sequence information containing information on a STC sequence in the clip, the play list information is comprised of a plurality of pieces of play item information, and play item information is information on a single still image.

FIG. 1

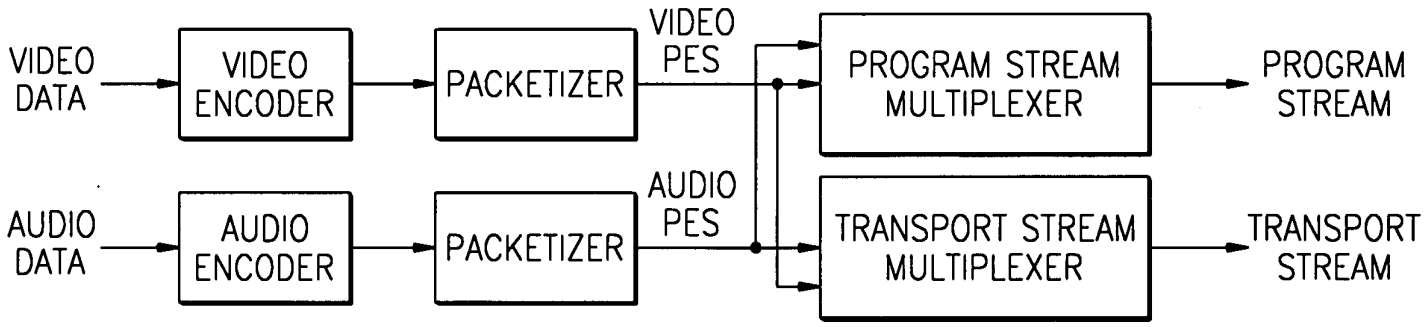

VIDEO DATA
VIDEO ENCODER
PACKETIZER
VIDEO PES
PROGRAM STREAM MULTIPLEXER
PROGRAM STREAM
AUDIO DATA
AUDIO ENCODER
PACKETIZER
AUDIO PES
TRANSPORT STREAM MULTIPLEXER
TRANSPORT STREAM

FIG. 2

PES_packet

Syntax	No. of bits
PES_paket() {	
packet_start_code_prefix	24
stream_id	8
PES_packet_length	16
if(stream_id != program_stream_map	
&& ,,,) {	
...	
if(PTS_DTS_flags == '10') {	
'0010'	4
PTS[32..30]	3
marker_bit	1
PTS[29..15]	15
marker_bit	1
PTS[14..0]	15
marker_bit	1
}	
if(PTS_DTS_flags == '11') {	
'0011'	4
PTS[32..30]	3
marker_bit	1
PTS[29..15]	15
marker_bit	1
PTS[14..0]	15
marker_bit	1
'0001'	4
DTS[32..30]	3
marker_bit	15
DTS[29..15]	1
marker_bit	15
DTS[14..0]	1
marker_bit	15
}	1
...	
Payload data	
}	

FIG. 3

Transport Stream Packet

Syntax	No. of bits
transport_packet() {	
sync_byte	8
...	
PID	13
..	
adaptation_field_control	2
..	
if(adaptation_field_control == '10' || adaptation_field_control=='11') {	
adaptation_field_length	8
if(adaptation_field_length>0) {	
...	
PCR_flag	1
...	
if(PCR_flag == '1' {	
PCR_base	33
reserved	6
PCR_extension	9
}	
...	
}	
...	
Payload data	
}	

FIG. 4

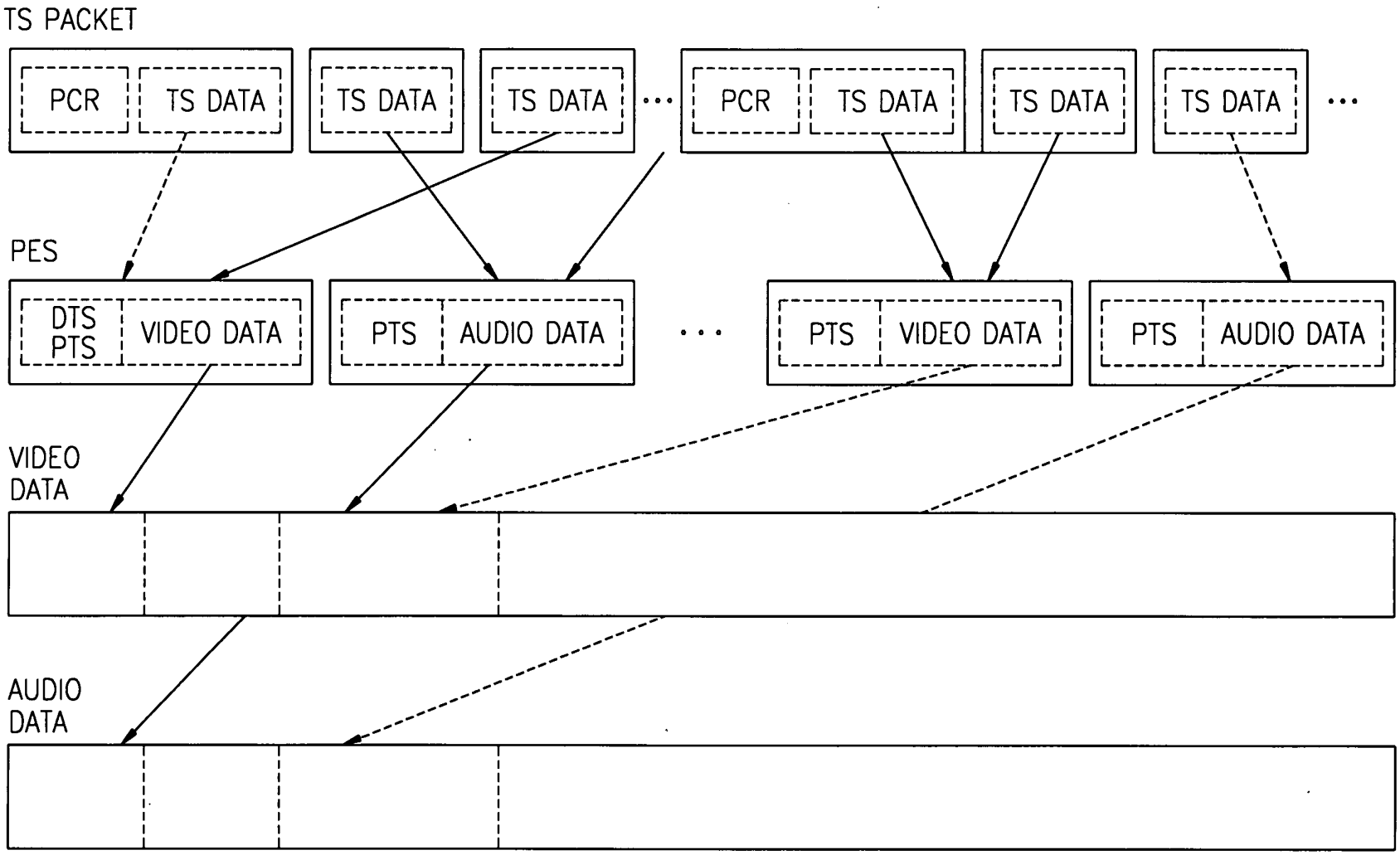

TS PACKET
PCR
TS DATA
TS DATA
TS DATA
PCR
TS DATA
TS DATA
TS DATA
PES
DTS
PTS
VIDEO DATA
PTS
AUDIO DATA
PTS
VIDEO DATA
PTS
AUDIO DATA
VIDEO
DATA
AUDIO
DATA

FIG. 5

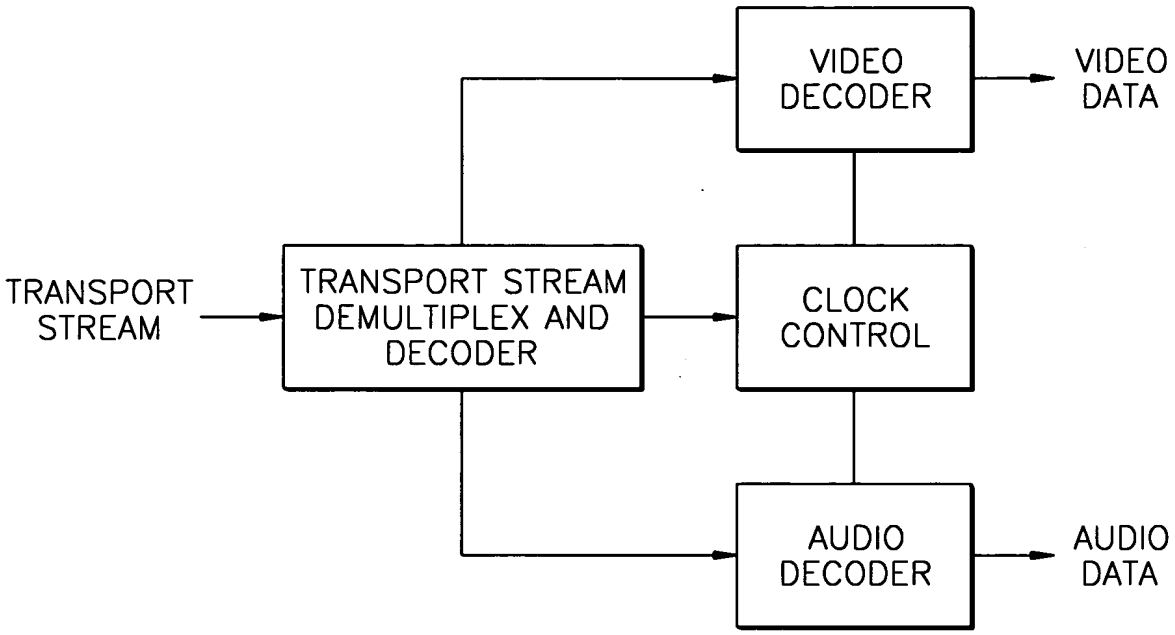

VIDEO DECODER
VIDEO DATA
TRANSPORT STREAM
TRANSPORT STREAM DEMULTIPLEX AND DECODER
CLOCK CONTROL
AUDIO DECODER
AUDIO DATA

FIG. 6

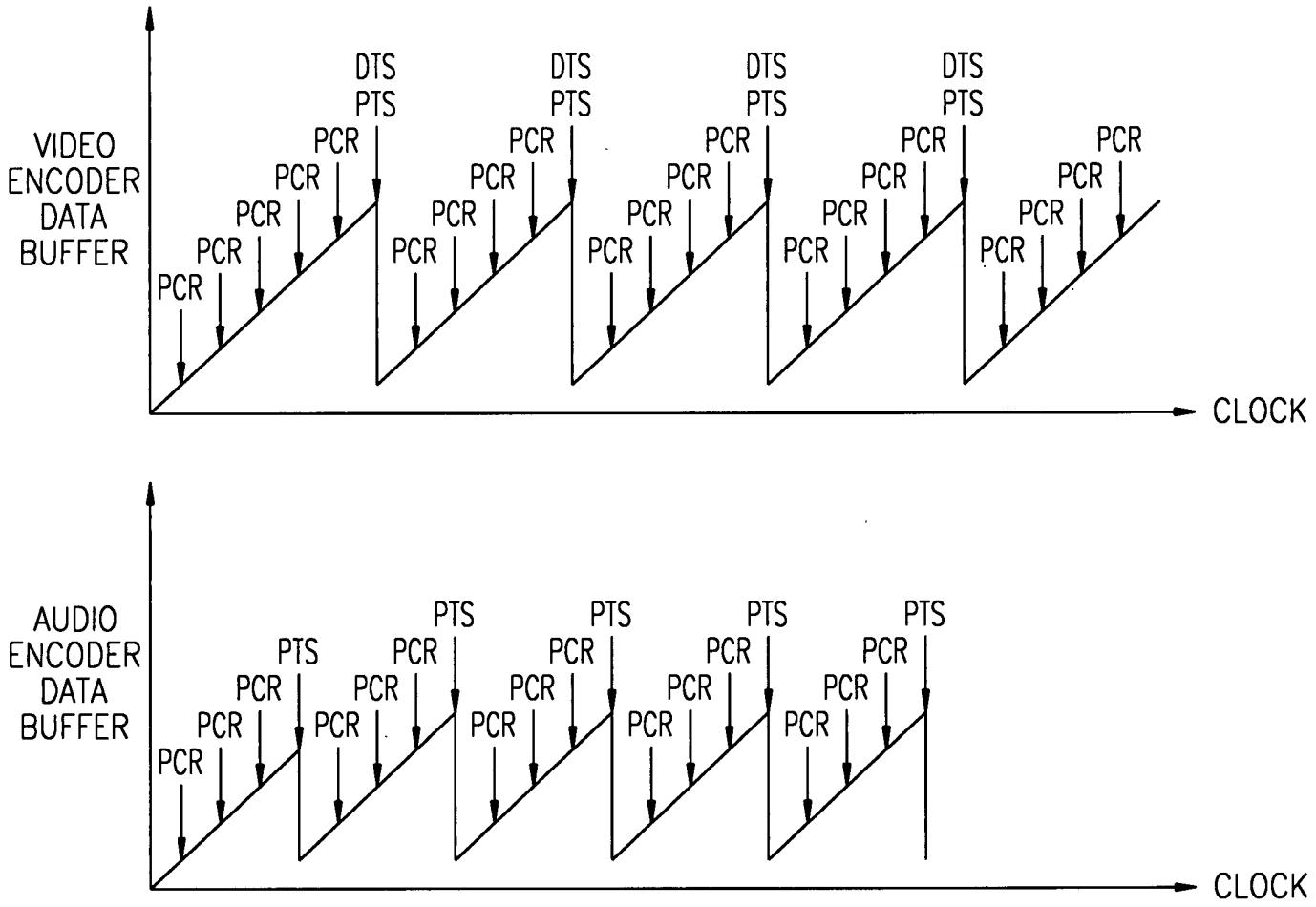

VIDEO ENCODER DATA BUFFER
DTS
PTS
PCR
CLOCK
AUDIO ENCODER DATA BUFFER
PTS
PCR
CLOCK

FIG. 7

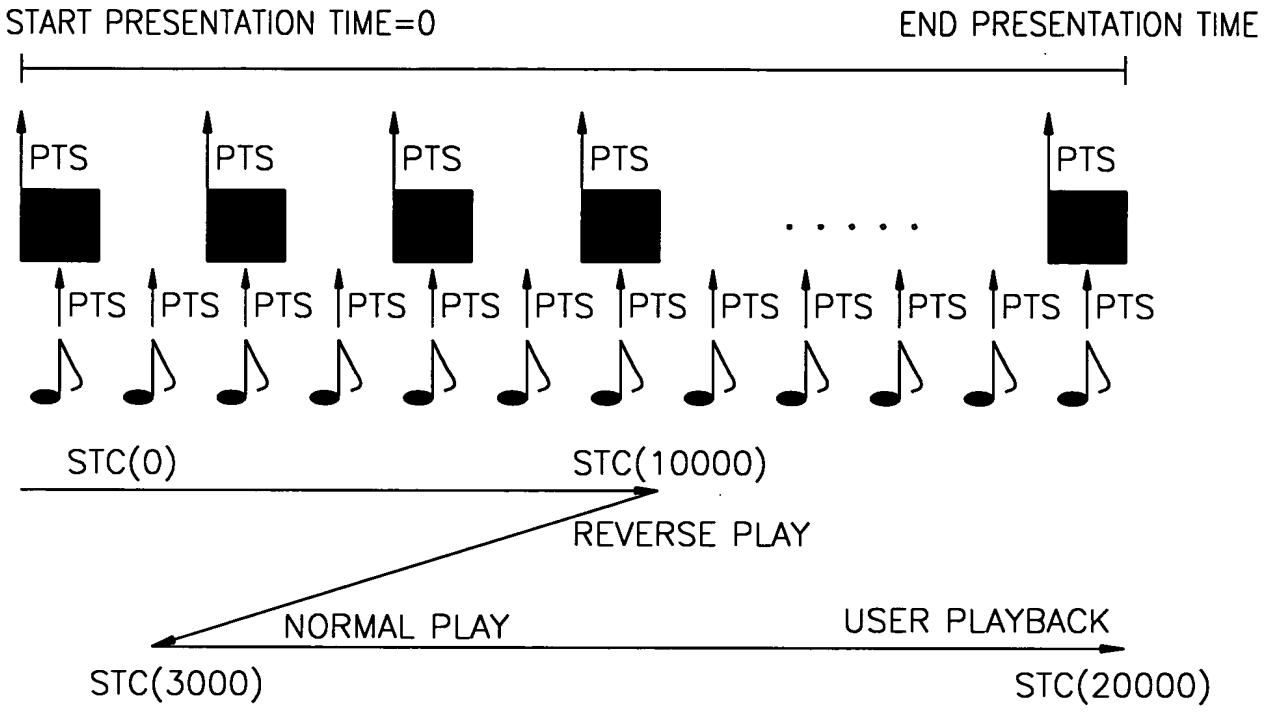

START PRESENTATION TIME=0
END PRESENTATION TIME
PTS
PTS
PTS
PTS
PTS
PTS
PTS
PTS
PTS
PTS
PTS
PTS
PTS
PTS
PTS
STC(0)
STC(10000)
REVERSE PLAY
NORMAL PLAY
USER PLAYBACK
STC(3000)
STC(20000)

FIG. 8

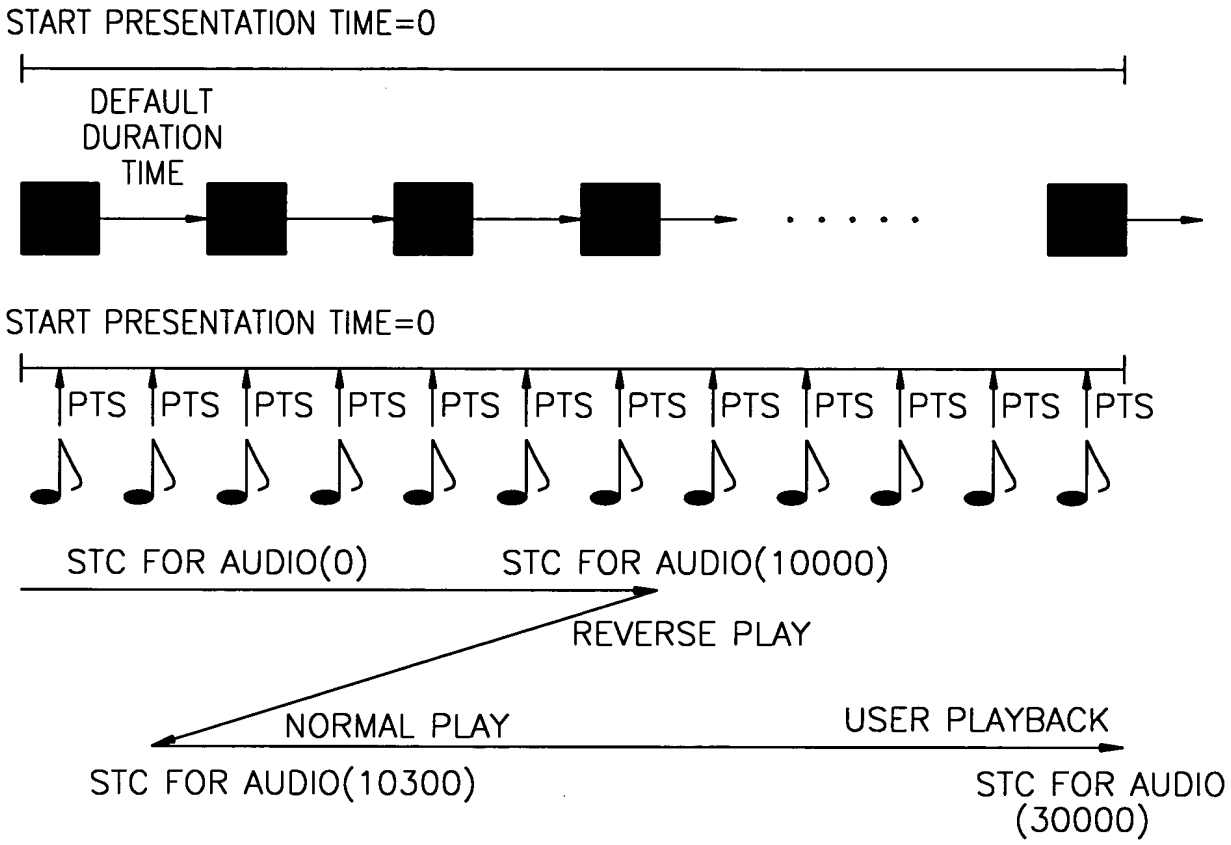

START PRESENTATION TIME=0
DEFAULT DURATION TIME
START PRESENTATION TIME=0
PTS PTS PTS PTS PTS PTS PTS PTS PTS PTS PTS PTS
STC FOR AUDIO(0)
STC FOR AUDIO(10000)
REVERSE PLAY
NORMAL PLAY
USER PLAYBACK
STC FOR AUDIO(10300)
STC FOR AUDIO (30000)

FIG. 9

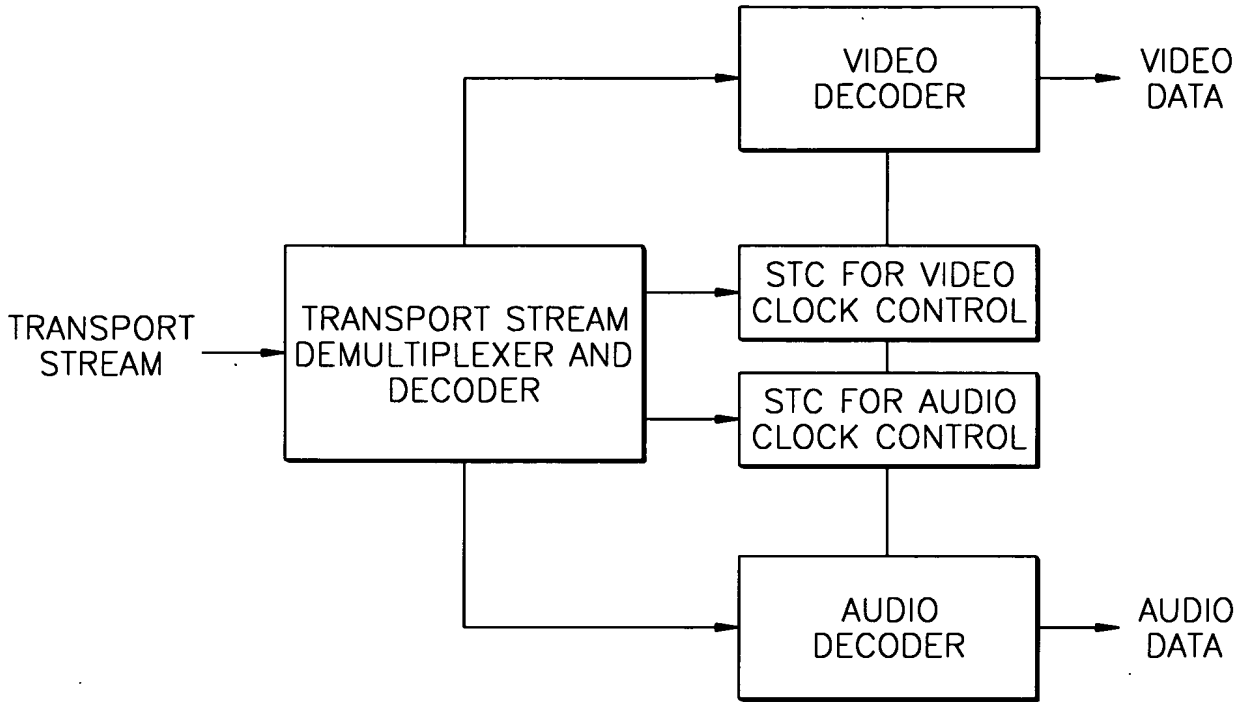

VIDEO DECODER
VIDEO DATA
TRANSPORT STREAM
TRANSPORT STREAM DEMULTIPLEXER AND DECODER
STC FOR VIDEO CLOCK CONTROL
STC FOR AUDIO CLOCK CONTROL
AUDIO DECODER
AUDIO DATA

FIG. 10

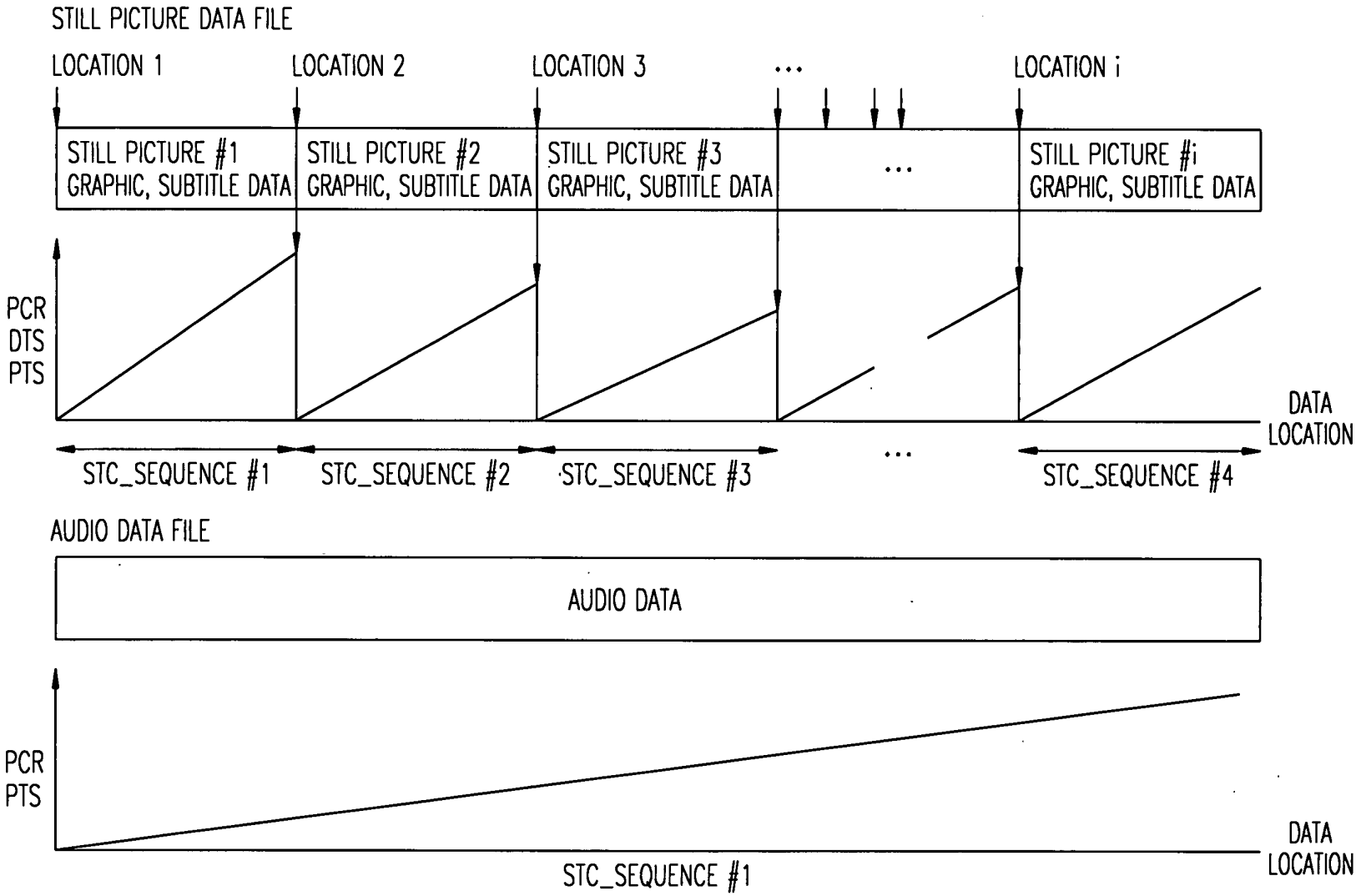

STILL PICTURE DATA FILE
LOCATION 1
LOCATION 2
LOCATION 3
...
LOCATION i
STILL PICTURE #1
GRAPHIC, SUBTITLE DATA
STILL PICTURE #2
GRAPHIC, SUBTITLE DATA
STILL PICTURE #3
GRAPHIC, SUBTITLE DATA
...
STILL PICTURE #i
GRAPHIC, SUBTITLE DATA
PCR
DTS
PTS
DATA
LOCATION
STC_SEQUENCE #1
STC_SEQUENCE #2
STC_SEQUENCE #3
...
STC_SEQUENCE #4
AUDIO DATA FILE
AUDIO DATA
PCR
PTS
DATA
LOCATION
STC_SEQUENCE #1

FIG. 11

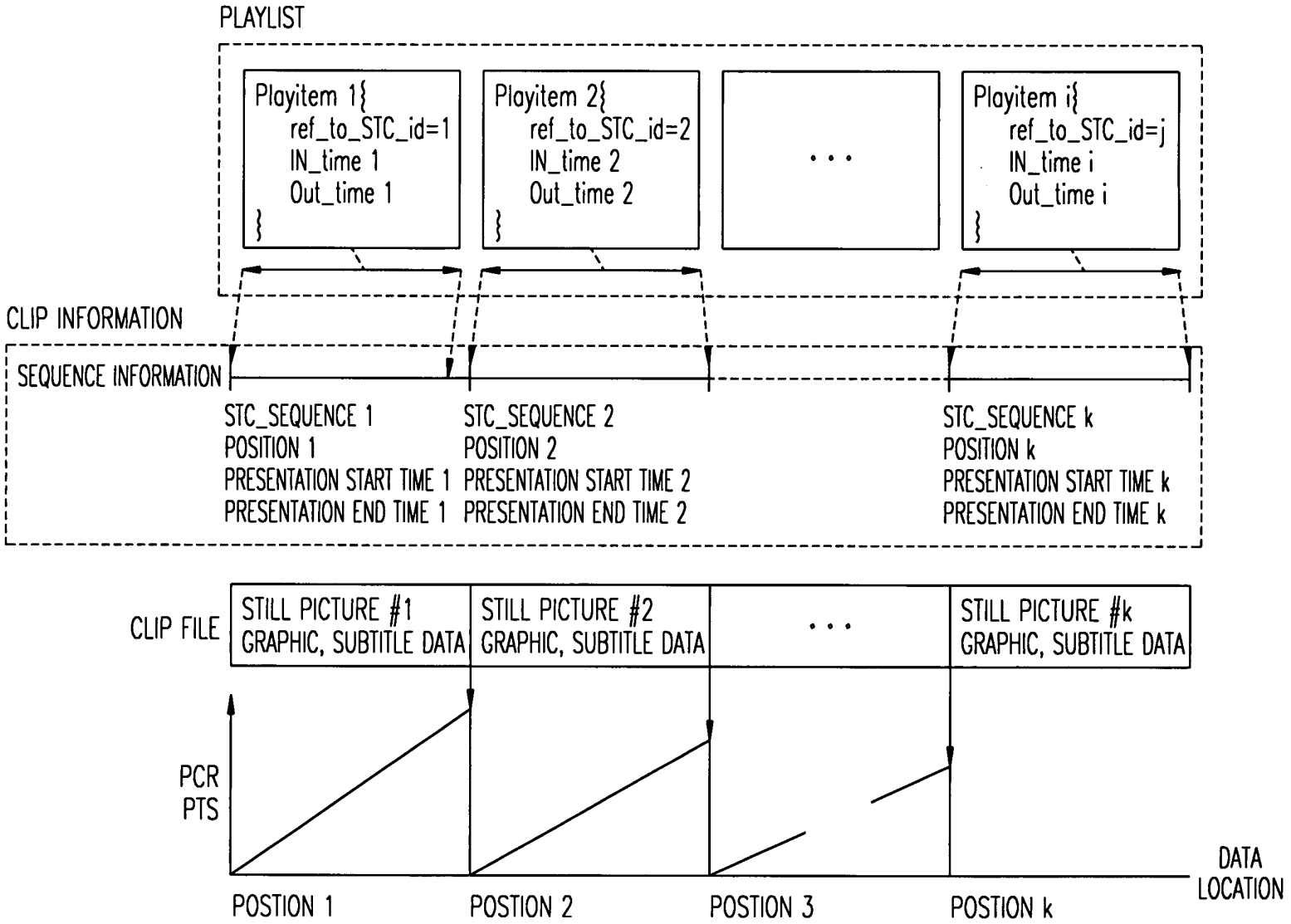

PLAYLIST
Playitem 1{
ref_to_STC_id=1
IN_time 1
Out_time 1
}
Playitem 2{
ref_to_STC_id=2
IN_time 2
Out_time 2
}
...
Playitem i{
ref_to_STC_id=j
IN_time i
Out_time i
}
CLIP INFORMATION
SEQUENCE INFORMATION
STC_SEQUENCE 1
POSITION 1
PRESENTATION START TIME 1
PRESENTATION END TIME 1
STC_SEQUENCE 2
POSITION 2
PRESENTATION START TIME 2
PRESENTATION END TIME 2
STC_SEQUENCE k
POSITION k
PRESENTATION START TIME k
PRESENTATION END TIME k
CLIP FILE
STILL PICTURE #1
GRAPHIC, SUBTITLE DATA
STILL PICTURE #2
GRAPHIC, SUBTITLE DATA
...
STILL PICTURE #k
GRAPHIC, SUBTITLE DATA
PCR
PTS
DATA
LOCATION
POSTION 1
POSTION 2
POSTION 3
POSTION k

FIG. 12

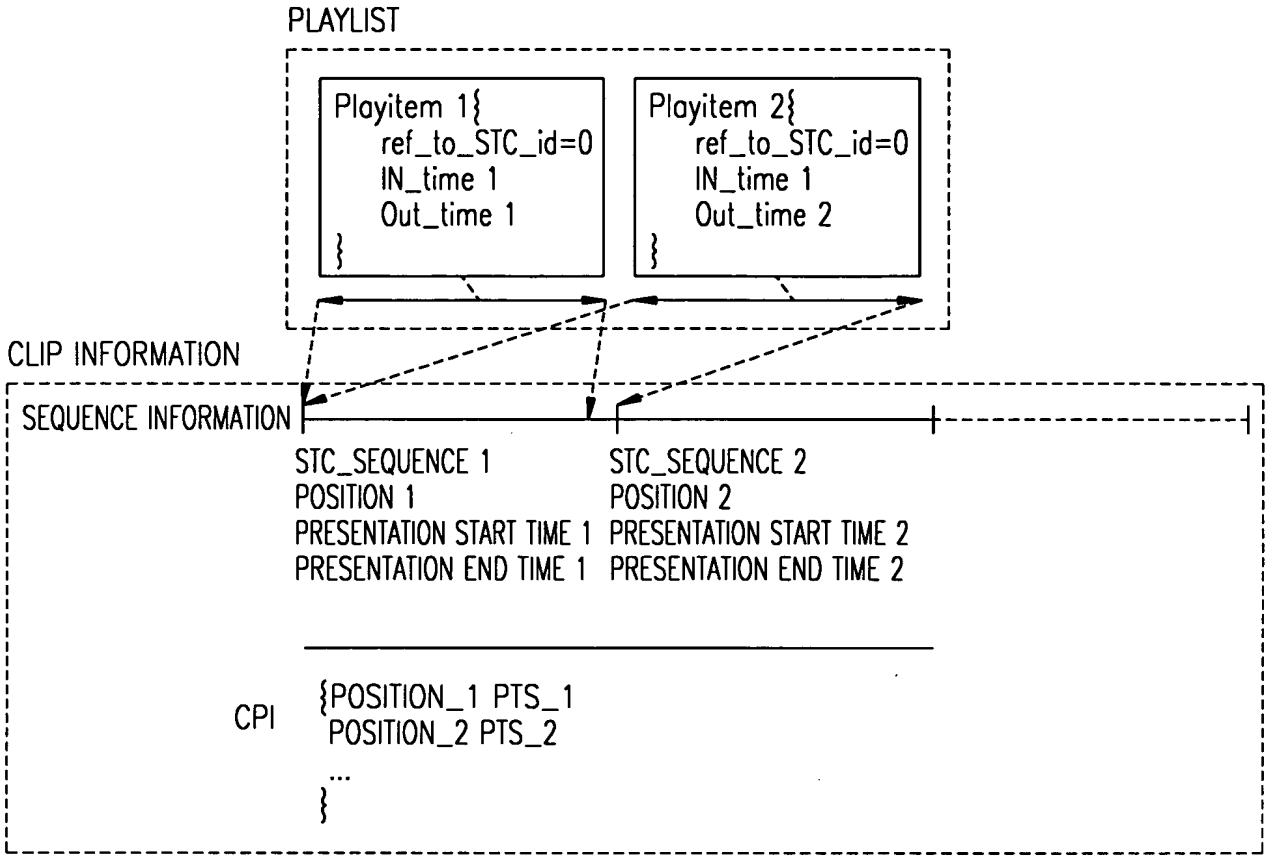

PLAYLIST
Playitem 1{
ref_to_STC_id=0
IN_time 1
Out_time 1
}
Playitem 2{
ref_to_STC_id=0
IN_time 1
Out_time 2
}
CLIP INFORMATION
SEQUENCE INFORMATION
STC_SEQUENCE 1
POSITION 1
PRESENTATION START TIME 1
PRESENTATION END TIME 1
STC_SEQUENCE 2
POSITION 2
PRESENTATION START TIME 2
PRESENTATION END TIME 2
CPI
{POSITION_1 PTS_1
POSITION_2 PTS_2
...
}

FIG. 13

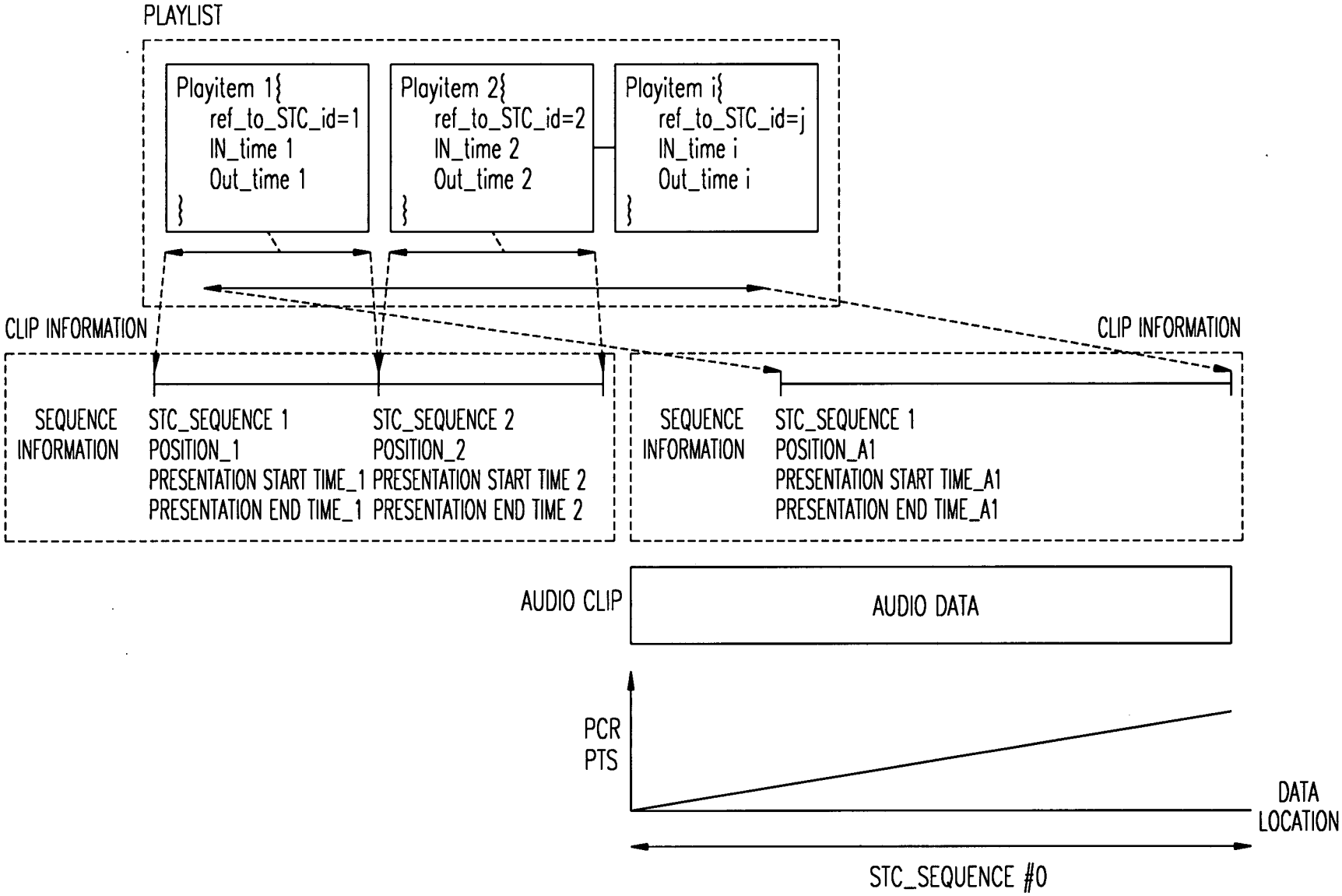

PLAYLIST
Playitem 1{
ref_to_STC_id=1
IN_time 1
Out_time 1
}
Playitem 2{
ref_to_STC_id=2
IN_time 2
Out_time 2
}
Playitem i{
ref_to_STC_id=j
IN_time i
Out_time i
}
CLIP INFORMATION
CLIP INFORMATION
SEQUENCE INFORMATION
STC_SEQUENCE 1
POSITION_1
PRESENTATION START TIME_1
PRESENTATION END TIME_1
STC_SEQUENCE 2
POSITION_2
PRESENTATION START TIME 2
PRESENTATION END TIME 2
SEQUENCE INFORMATION
STC_SEQUENCE 1
POSITION_A1
PRESENTATION START TIME_A1
PRESENTATION END TIME_A1
AUDIO CLIP
AUDIO DATA
PCR
PTS
DATA LOCATION
STC_SEQUENCE #0

FIG. 14

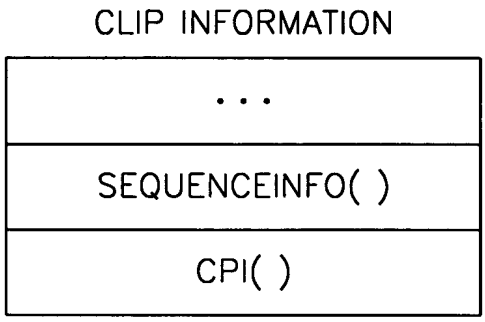


FIG. 15

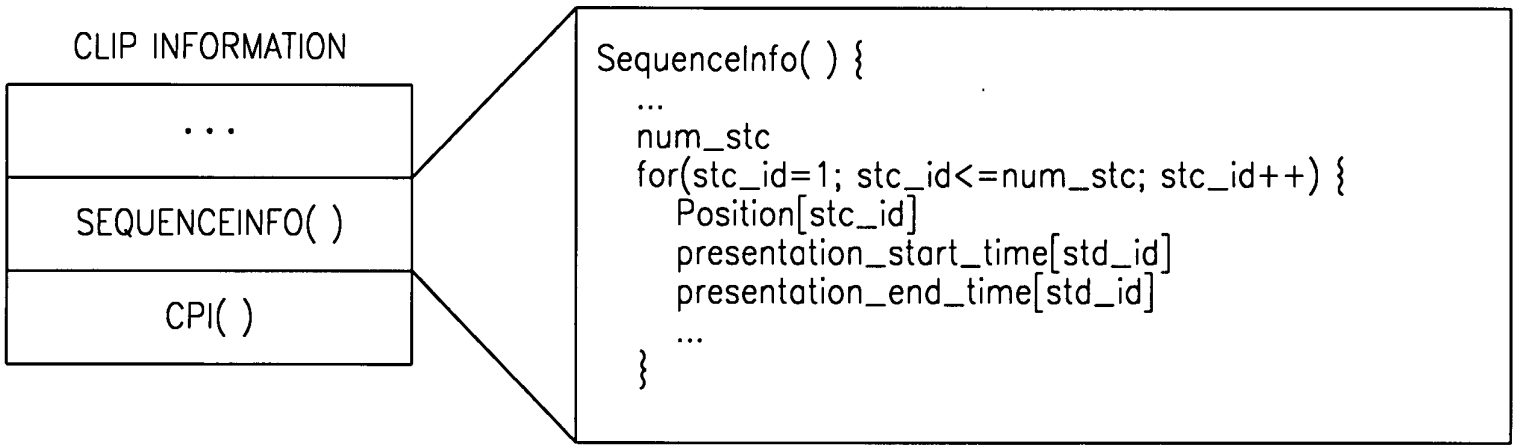

CLIP INFORMATION
...
SEQUENCEINFO( )
CPI( )
SequenceInfo( ) {
...
num_stc
for(stc_id=1; stc_id<=num_stc; stc_id++) {
Position[stc_id]
presentation_start_time[std_id]
presentation_end_time[std_id]
...
}

FIG. 16

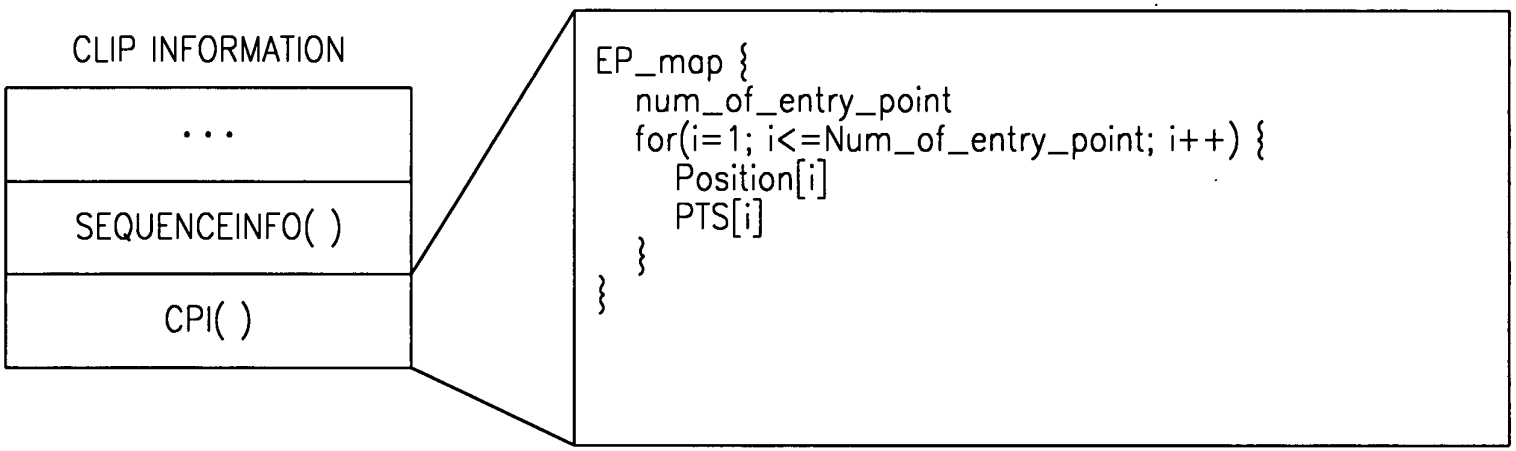

CLIP INFORMATION
• • •
SEQUENCEINFO( )
CPI( )
EP_map {
num_of_entry_point
for(i=1; i<=Num_of_entry_point; i++) {
Position[i]
PTS[i]
}
}

FIG. 17

PlayItem

Syntax

PlayItem( ) {
Clip_Information_file_name
STC_id
IN_time
OUT_time
...
}

FIG. 18

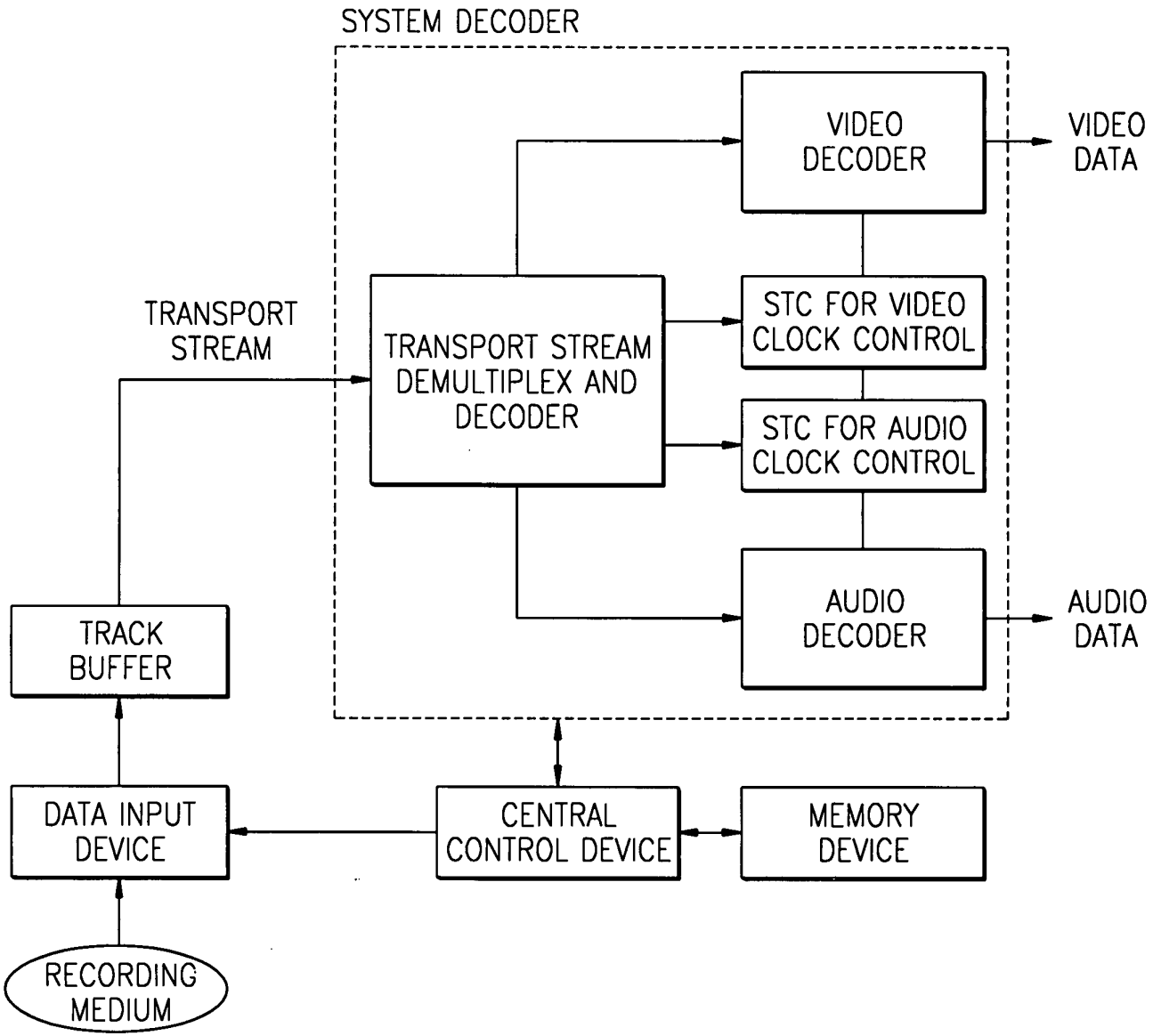
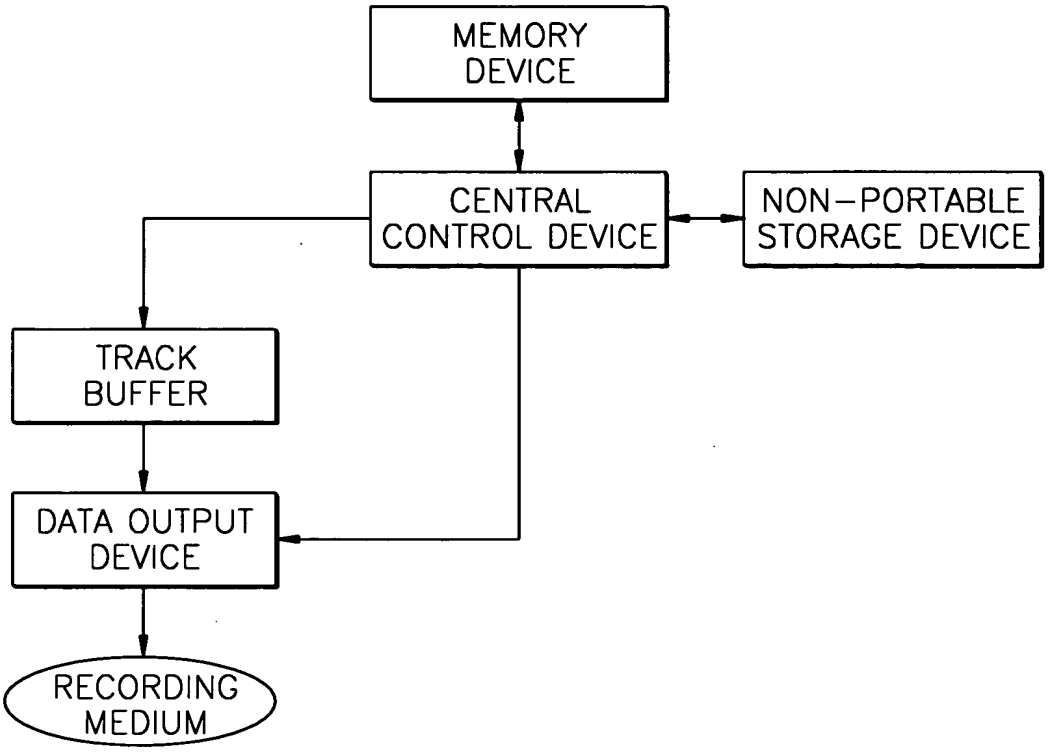

SYSTEM DECODER
VIDEO DECODER
VIDEO DATA
TRANSPORT STREAM
TRANSPORT STREAM DEMULTIPLEX AND DECODER
STC FOR VIDEO CLOCK CONTROL
STC FOR AUDIO CLOCK CONTROL
AUDIO DECODER
AUDIO DATA
TRACK BUFFER
DATA INPUT DEVICE
CENTRAL CONTROL DEVICE
MEMORY DEVICE
RECORDING MEDIUM

FIG. 19


MEMORY DEVICE
CENTRAL CONTROL DEVICE
NON-PORTABLE STORAGE DEVICE
TRACK BUFFER
DATA OUTPUT DEVICE
RECORDING MEDIUM